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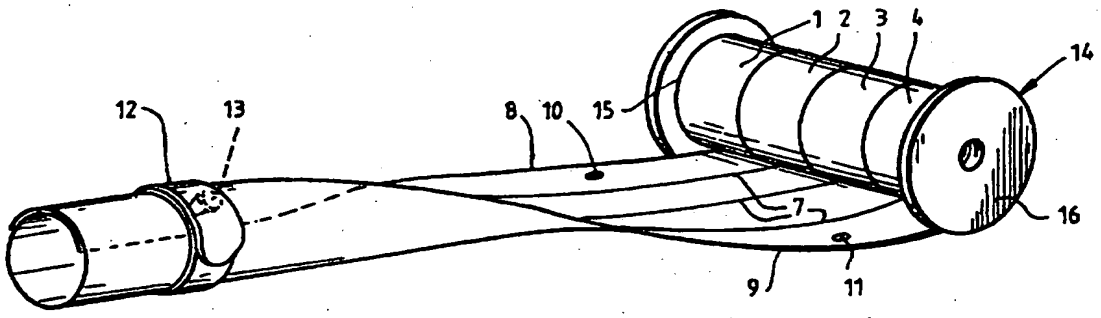
(54) Title: COLLAPSIBLE STRUCTURAL MEMBER



(57) Abstract

A generally cylindrical structural member comprising four thin high-tensile heat-treated stainless steel spring strips (1-4) of the type used in the manufacture of flexible measuring tapes, flexibly joined at their adjacent edges by vinyl adhesive tape (5 and 6) to create a hinge (7) between the adjacent edges of the strips (1-4), each strip (1-4) having a curved cross section so that the connected strips form a cylindrical structural member when the free edges (8 and 9) of the outermost strips (1 and 4) are overlapped and connected by a binding strip (12) carrying a locking pin (13) which engages holes (10 and 11) formed in the overlapped edges to hold the overlapped edges in the assembled condition to form a rigid structural member, such as a tent pole.

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COLLAPSIBLE STRUCTURAL MEMBER

Field of the Invention

This invention relates to improvements in structural members such as poles, columns, beams, struts and the like.

Background of the Invention

The need for a readily collapsible structural member, such as a pole, is self-evident to any person frustrated by the need to store and carry tent poles. While tent poles formed from interfitting pole elements reduce the storage problem slightly, the elements can become misplaced thereby rendering the remaining elements useless. Other devices having structural members having longitudinal rigidity, such as aerial/lighting masts, are also able to benefit by being collapsible or coilable.

Numerous proposals for collapsible or coilable structural members are to be found in the patent literature, but none of these proposals has thus far found commercial success. For example, International Publication WO87/05067 describes a coilable structural member comprising a series of block members hinged together so as to be coilable but being rigid when uncoiled. A similar arrangement is disclosed in U.S. Patent No 3925943, Petri, in which the block members are formed from a length of flexible material. Each of the above proposals has the disadvantage of being relatively expensive to manufacture and comparatively bulky when in its coiled form.

Summary of the Invention and Object

It is an object of the present invention to provide an improved structural member having a less bulky construction than the proposals outlined above and which nevertheless provides a functional structural member which can be coiled into a compact form for storage.

The invention provides a structural member comprising a multiplicity of elongate thin flexible elements flexibly joined to each other in the longitudinal direction to form an open sided assembly of elements having free edges, means for connecting the free edges of the elements to define a closed structural member having compressive strength but being coilable when said edges are disconnected.

By using flexibly connected thin flexible elements to define the structural member, the structural member has a high strength to weight ratio, a large size to stored volume ratio and is easily manually assembled without welding. The structural member is suitable for use in any situation that requires a lightweight compression member, for example, camping equipment tent poles, walking sticks, chair legs, storage stands, roll-up signs with integrated supports, tools requiring extendible handles, surveying and photographic equipment requiring tripods, survey poles, temporary barricades and aerial or lighting masts. The structural members can also be used in the construction of small bridges in remote areas where vehicle access is difficult.

In one form of the invention, at least three elements are used, each element comprising a thin high tensile steel strip of the type used in the manufacture of flexible measuring tapes. Each strip is preferably cold rolled to create a curved cross section having the required dimensions. The elements are joined at their adjacent edges by a flexible connection which allows the elements to be formed into a generally cylindrical structure with its free edges connected together.

The flexible connection can take any convenient form. For example, adhesive tape applied to the opposite faces of adjacent edges of the elements forms a satisfactory flexible connection enabling the formation of a rigid structure which is coilable for storage. Preferably, the tape covers the opposite faces of the steel strips to provide protection against corrosion and mechanical damage.

Where only three elements are used, the free edges are partially overlapped or butted together and are suitably connected to prevent the structural member opening. Where four elements are used, the free edges are preferably fully overlapped and are pinned together to increase the structural integrity of the structural member.

The means for connecting the free edges may comprise a series of spaced binding strips, preferably having a locking pin which engages aligned holes in the overlapping free edges of the elements to positively locate the free edges with respect to each other. Although it is desirable to positively locate the free edges by means of pins or the like, an acceptable structural member can be formed for

some uses by simply binding the butted or overlapped edges together, say by means of adhesive tape applied around the structural member at spaced intervals applied longitudinally over the butted or overlapped edges.

A stronger structural member can be created by forming the butted or partially overlapped adjacent edges of the elements with an array of alignable perforations adapted to receive a corresponding array of pins or hooks, preferably carried by a flexible backing strip, and capable of insertion into the holes by means of a mechanical slider engaging the edges of the flexible strips. Other more complex arrangements are described in greater detail below.

The flexible elements are preferably coilable onto one or more formers and the formers can also perform the function of containing the ends of the structural member in the assembled condition.

Brief Description of the Drawings

In order that the invention may be more readily understood several embodiments of the invention will now be described with reference to the accompanying drawings in which:

Figure 1 is a fragmentary perspective view of a structural member in the partly assembled and coilable condition according to a first embodiment;

Figure 2 is a similar perspective view of a second embodiment;

Figure 3 is a schematic perspective view of a third embodiment;

Figure 4 is a fragmentary schematic perspective view of the structural member before assembly with an enlarged fragmentary sectional elevation of the flexible hinge connection;

Figure 5 is an elevation of an assembled tent pole according to the embodiment of Figure 1;

Figure 6 is a sectional elevation of the tent pole detailing the end fittings; and

Figures 7 and 8 are sectional elevations of two further assembled structural members.

Description of Preferred Embodiments

Referring firstly to Figures 1 and 4, the first embodiment of the invention

comprises four thin high-tensile heat-treated spring stainless steel strips 1 to 4 of the type which are used in the manufacture of flexible measuring tapes, flexibly connected at their adjacent edges by vinyl adhesive tape 5 and 6 to create a flexible joint or hinge 7 between the adjacent edges of the strips 1 to 4. In the present embodiment, the vinyl tape covers each strip 1 to 4 to provide protection against corrosion and mechanical damage.

Each strip 1 to 4 has been cold rolled to create a curved cross-section so that the connected strips form a cylindrical structural member when the free edges 8 and 9 of the outermost strips 1 and 4 are overlapped and connected in a suitable manner. In the embodiment shown in Figure 1, the strips 1 and 4 are formed with a series of spaced holes 10 and 11 which are aligned when the edges 8 and 9 are overlapped in the manner shown in Figure 1 and a binding strip 12 carrying a locking pin 13 which engages the holes 10 and 11 to hold the overlapped edges 8 and 9 in the assembled condition to form a rigid structural member, such as a tent pole (Figure 5). The binding strip 12 has velcro elements on its overlapped portions to hold the binding strip in the assembled position.

As shown in Figure 1, the coiled strips 1 to 4 are carried by a storage drum 14 comprising a pair of elements 15 and 16 which are fitted to the ends of the structural member as shown in Figure 6 of the drawings to complete the ends of the tent pole. When the strips are coiled, as shown in Figure 1, the binding strips 12 can be used to keep the strips in their coiled condition, as shown schematically in Figure 5 of the drawings.

It will be appreciated from the above that the structural member shown in Figure 1 of the drawings has extremely high strength and large size for its weight and can be coiled so as to be stored within a volume which is very small compared to the size of the assembled structural member.

In the embodiment shown in Figure 2 of the drawings, a three strip structure is shown in which the free edges are perforated at 20 to receive correspondingly spaced hooks 21 supported by a flexible backing 22 and applied to the butted or partially overlapped free edges of the strips by a mechanical slider 23 which engages the free edges and pushes the hooks through the aligned holes 20 as the

slider is moved along the length of the strips. This arrangement enables the structural member to be rapidly assembled and forms a somewhat stronger structural member compared with the embodiment of Figure 1. Otherwise, the structural member is the same in principle to the structural member shown in Figure 1.

In the embodiment of Figure 3, three overlapped strips 30, 31 and 32 having perforated overlapped edges 33 are joined by high strength joining ribbons 34 which are forced through the perforated edges by a hand or power operated mechanical feed device 35 with tapered locking pins engaging loops 36 in the ribbon 34 to hold the assembly together.

Figures 7 and 8 of the drawings show further examples of storage drum end-connector configurations, the construction of each of which will be self-evident from the drawings, and which includes a cylindrical groove in each end-connector dimensioned to receive the ends of an assembled structural member to contain the ends and to provide functional fittings for the ends. For example in Figure 6 the end element 15 provides a tent pole supporting base while the element 16 provides a top end fitting with a locating pin which also functions as a threaded connecting bolt for forming the storage drum 14. Other threaded connectors are shown in Figures 7 and 8.

In the case of Figure 8, an internal spring S provides additional rigidity against bending or buckling of the structural member, which is otherwise formed as previously described.

It will be appreciated that other embodiments employing the principle of the invention described above will be readily apparent to persons skilled in the art. The possible uses of structural members embodying the invention detailed above constitute only a small number of the possible uses to which the structural member embodying the invention may be put. The structural member offers significant advantages over the prior art structural members referred to above, particularly in relation to the large size to stored volume ratio and the high strength to weight ratio.

CLAIMS:

1. A structural member comprising a multiplicity of elongate thin flexible elements flexibly joined to each other in the longitudinal direction to form an open sided assembly of elements having free edges, means for connecting the free edges of the elements to define a closed structural member having compressive strength but being coilable when said edges are disconnected.

2. The structural member of claim 1, wherein there are three elements flexibly joined at their adjacent edges.

3. The structural member of claim 1 or 2, wherein each element comprises a thin high-tensile stainless steel strip having a curved cross-section, of the type used in tape measures, said elements being joined at their adjacent edges by a flexible connection which enables the elements to form a generally cylindrical structure when the free edges of the member are connected together.

4. The structural member of claim 2 or 3, wherein said adjacent edges are butted together or overlapped and are connected to prevent the structural member opening.

5. The structural member of claim 2, 3 or 4, wherein said free edges are butted together or overlapped and are secured to each other to prevent the structural member opening and to increase the structural integrity of the structural member.

6. The structural member of claim 4 or 5, wherein said adjacent edges and/or said free edges are connected by a binding strip.

7. The structural member of claim 6, wherein said binding strip comprises adhesive tape adhesively secured to said elements longitudinally over the butted or overlapped edges.

8. The structural member of claim 6, wherein said binding strip carries one or more locking pins or hooks engaging aligned holes in the overlapping free edges of said elements to positively locate the free edges with respect to each other.

9. The structural member of claim 8, further comprising a mechanical slider which engages said free edges and pushes said pins or hooks through said aligned holes as the slider is moved along the length of the strips.

10. The structural member of claim 6, wherein said binding strip is located internally of said structural member, with looped portions of said binding strip projecting through aligned holes in overlapping free edges of said strips, said looped portions being engaged by locking pins.

11. The structural member of claim 8, comprising a plurality of said binding strips extending circumferentially of said structural member, each binding strip carrying a pin which engages aligned holes in the overlapping free edges of said elements.

12. The structural member of any preceding claim, further comprising end connectors enclosing the ends of the structural member.

13. The structural member of claim 12, wherein said end connectors include means for connecting the end connectors together to form a storage drum for the structural member when in its coiled condition.

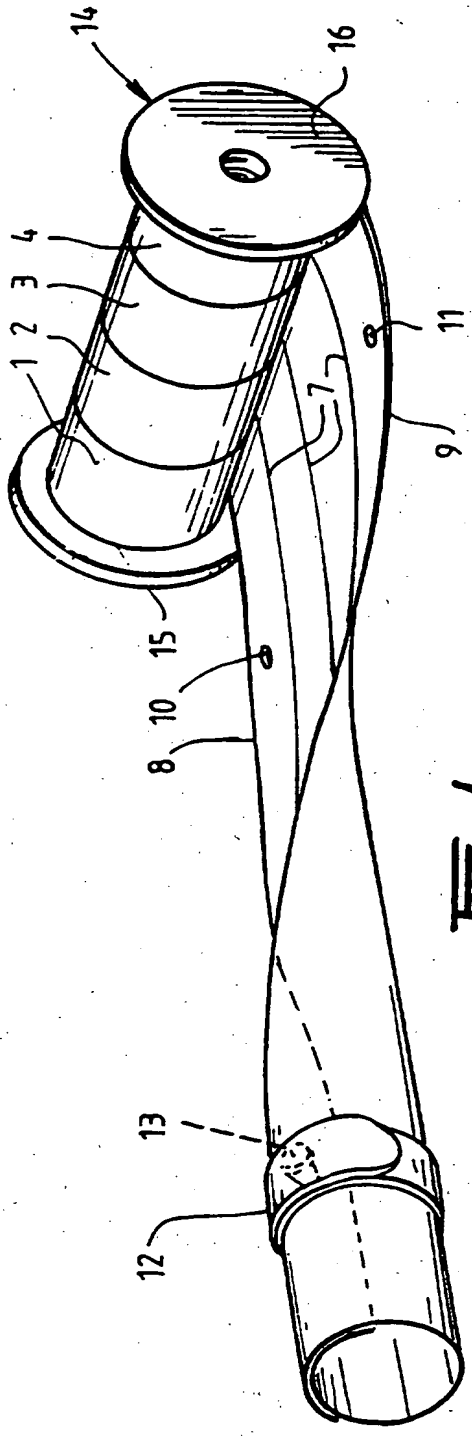


Fig. 1.

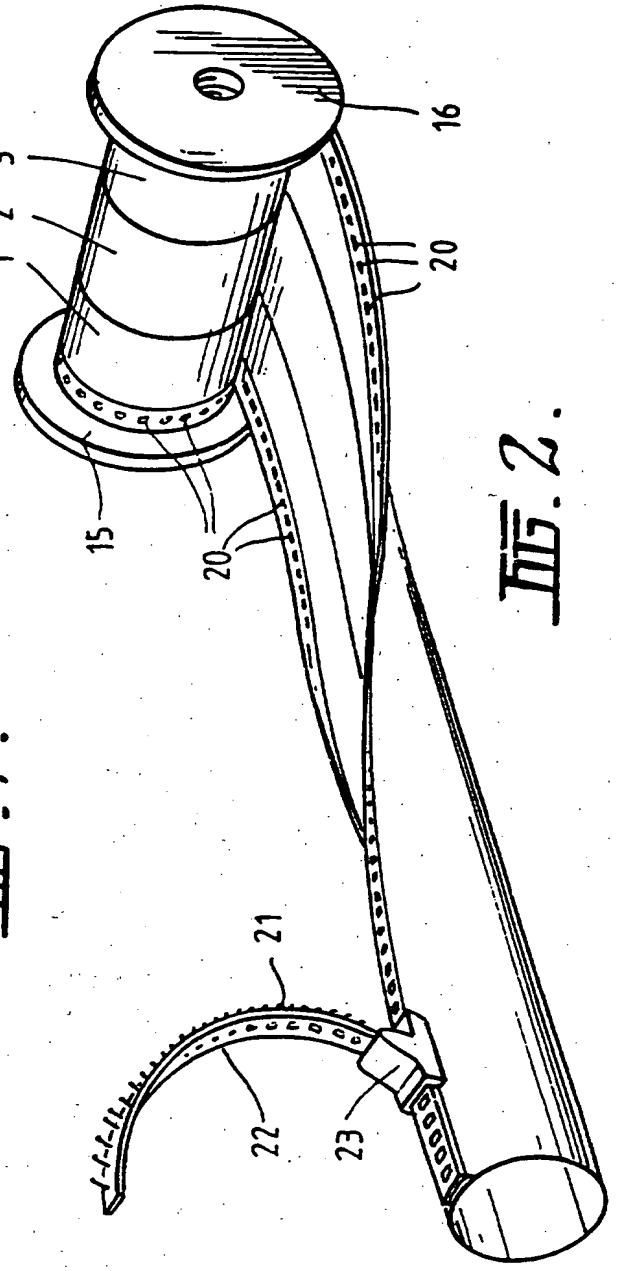
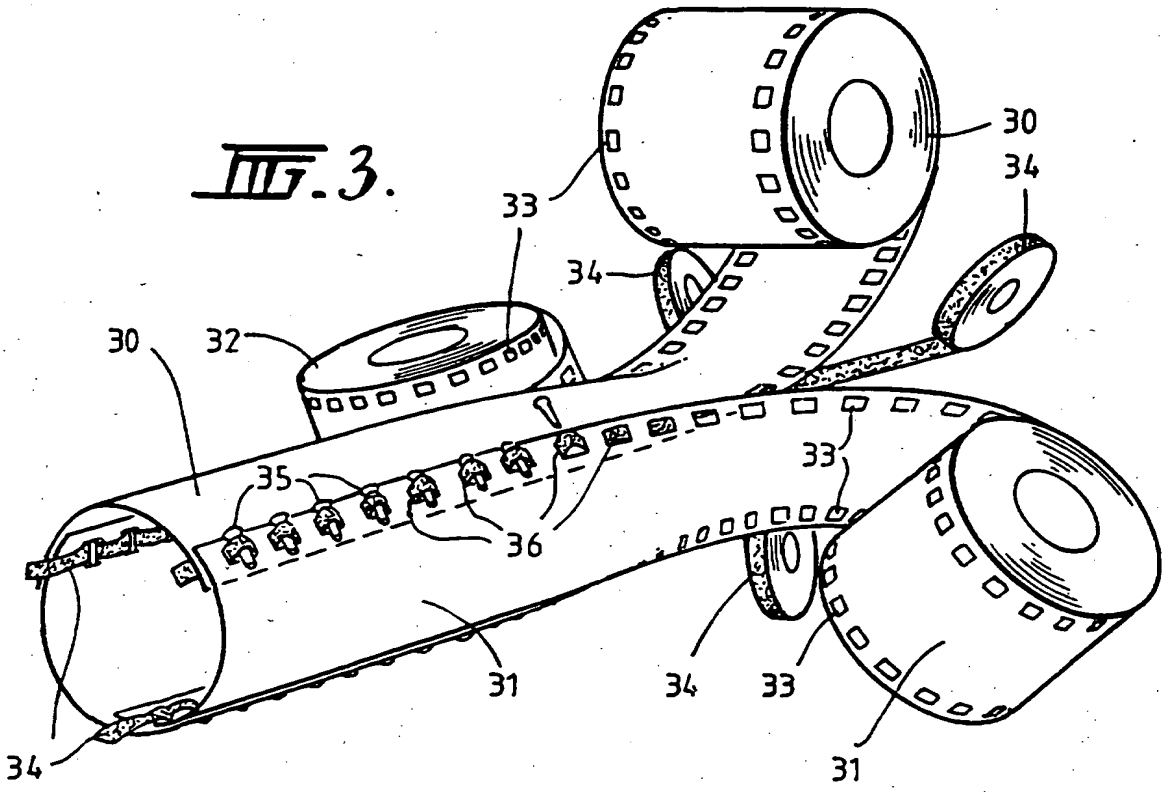


Fig. 2.

FIG. 3.



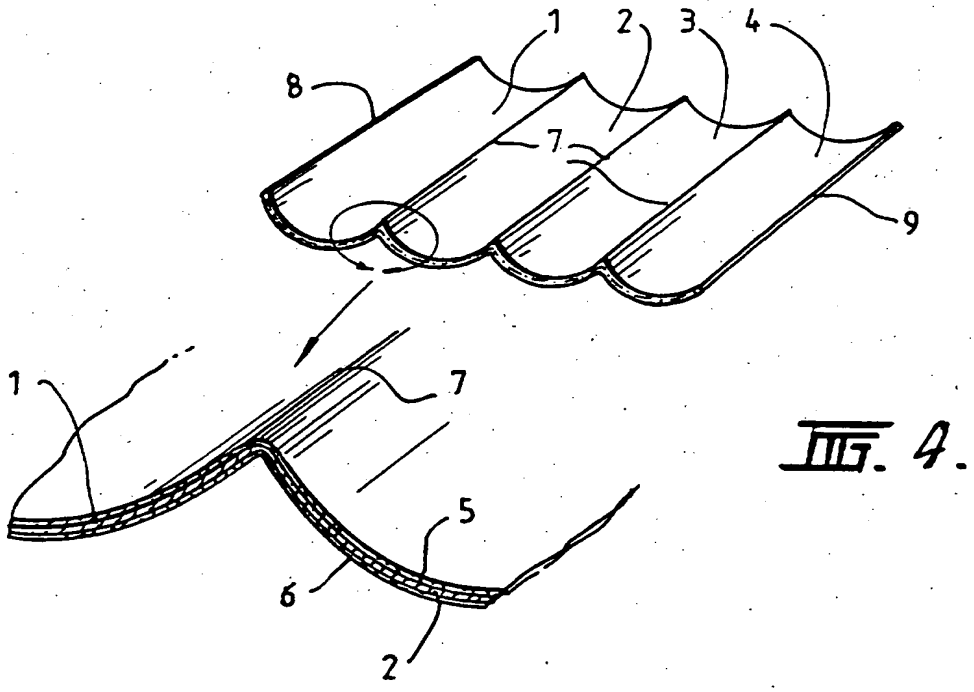


FIG. 4.

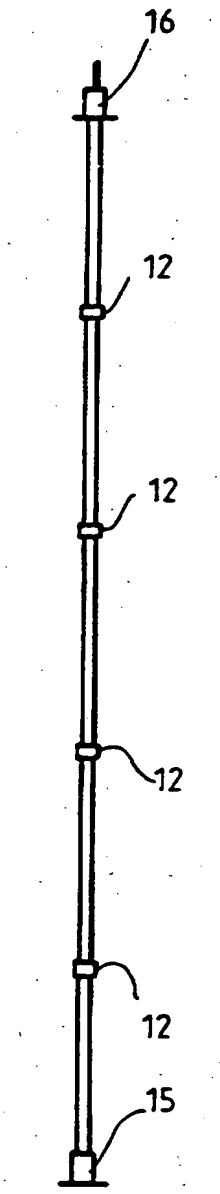


FIG. 5.

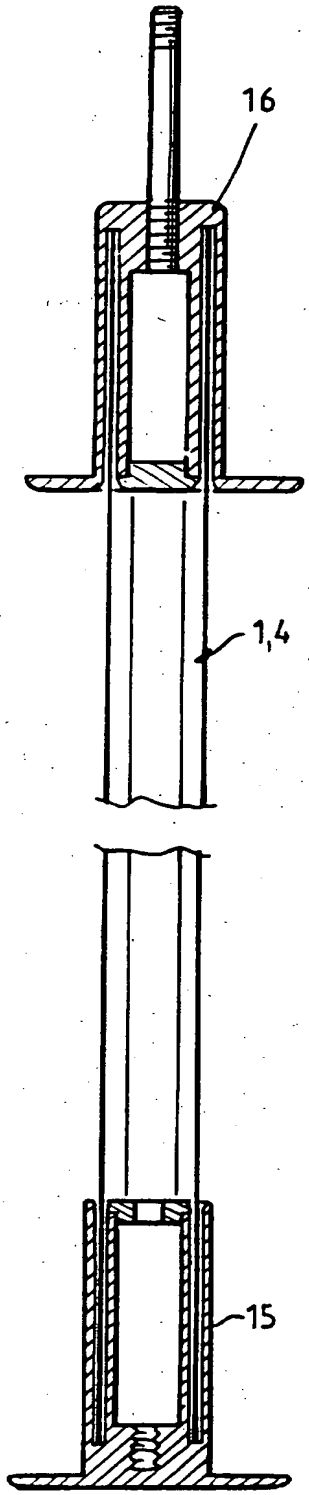


FIG. 6.

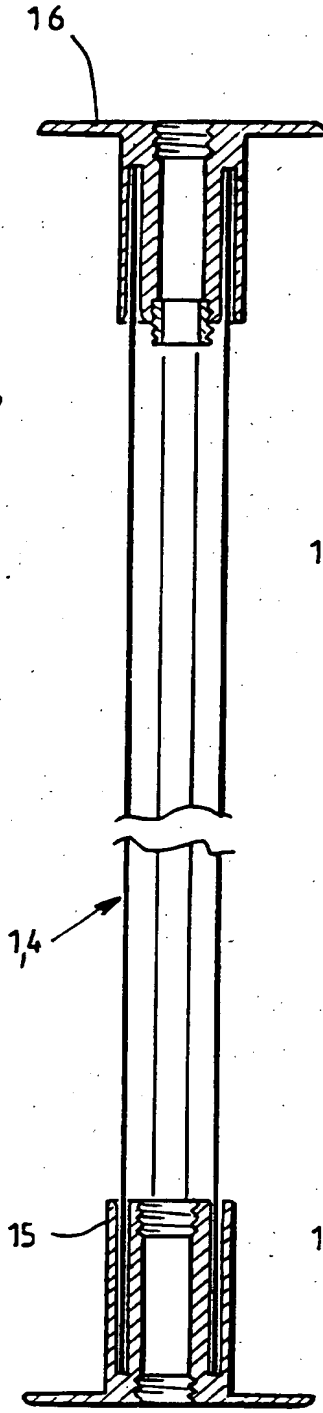


FIG. 7.

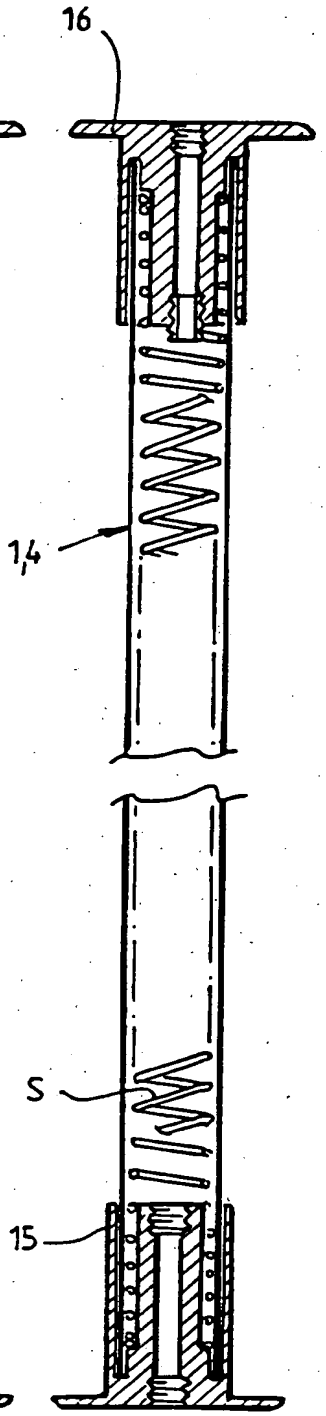


FIG. 8.

INTERNATIONAL SEARCH REPORT

International Application No.
PCT/AU 95/00596

A. CLASSIFICATION OF SUBJECT MATTER

Int Cl[6]: F16S 3/02; F04H 12/00, 12/08, 12/34, 15/16; F16M 13/08; E04C 3/30

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B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC : F16S 3/02; E04H 12/00, 12/08, 12/34, 15/16; F16M 13/08; E04C 3/30

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CH 670692 A (KANZIG) 30 June 1989 See figure 1	1
X	US 3503164 A (BERRY et al) 31 March 1970 See figures 1 and 2	1-6
X	US 4850161 A (McGLINNIS) 25 July 1989 See figure 4	1-6

[X] Further documents are listed in the continuation of Box C

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X	US 4651480 A (KRAMER) 24 March 1987 See figures 1 and 2	1, 2, 4, 5
X	US 4625475 A (McGLINNIS) 2 December 1986 See Column 1 lines 35-60	1-6
X	US 4386485 A (KRAMER) 7 June 1983 See Figure 1	1, 4, 5
X	AU 32533/89 B (605971) (RAPID DEPLOYMENT TOWERS INC) 12 October 1989 See Figures 3-5	1-6
X	AU 5826/66 B (293241) (SANDERS ASSOCIATES, INC) 23 November 1967 See Figure 1	1-6
X	SE 459267 A (SÖKANDE) 19 June 1989 See Figures 1-6	1-6

INTERNATIONAL SEARCH REPORT
Information on patent family members

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